This ATM describes the test results of the Pre-Integration, Integration and Crosstalk Tests performed on the Passive Seismic, Magnetometer and Solar Wind experiments, thru the period of March -April 1967.

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General

This ATM summarizes test results during the initial Pre-Integration Acceptance (PIA) testing, Integration testing, and Crosstalk testing of Prototype Model experiments. These experiments included the LSM, SWS, PSE and CCGE. The SIDE experiment Prototype Model was not available at the time period of these tests. Subsequent to these tests the SWS, PSE and CCGE were returned to their suppliers for modifications. The purpose of these tests were:

1) Determine the performance capabilities and limitations of each experiment. Comparisons to engineering model performance was made.

2) Initial integration of each experiment with the Central Station, determination of electrical interfaces and check-out of software.

3) Validation of test procedures to be used on subsequent models.

4) Preliminary investigation of Crosstalk problems with multiple experiments "on-line" simultaneously.

Because of the necessity of returning Prototype experiments to suppliers not all problems noted during EM tests have been completely investigated. This will be completed when the Prototype are returned to Bendix commencing May 10, 1967.

This report includes a summary of experiment performance and limitations and photographs of electrical interfaces. Exact performance during each test can be determined by review of the test procedures that were rigidly followed during each test.

1.0 SOLAR WIND SPECTROMETER EXPERIMENT PROTOTYPE TEST RESULTS

1.1 General

The Solar Wind Experiment was the first experiment to be integrated to the ALSEP Central Station. Checkout of the experiment, by EOS and JPL personnel at BxA, began on the morning of 15 March 1967. The Prototype was run through the Pre-Integration Test (PIA) at 10:00 AM on 16 March 1967. Integration to the Central Station, except for formal documentation (i.e., photographs), was completed at approximately 6:00 PM on the same day. A test of the dust cover removal mechanism was made in vacuum the following day. The experiment then left BxA for sensor calibration tests and was returned on 10 April for crosstalk tests with the other Array A experiments. The experiment arrived without proper paperwork and was held in Inspection until late in the afternoon of 13 April. Subsystem documentation of waveforms was completed on 14 April. The experiment was cleaned and vacuum of 10^{-4} torr was achieved the same day. A four-hour pumpdown at 10^{-4} is required to eliminate corona whenever the experiment is run with the "high voltage inhibit" plug inserted. This was achieved at noon on 15 April. The second PIA was completed in approximately 2 hours, 40 minutes. Several corrections were made to the PIA to allow for vacuum operation during this test. Quality Assurance and DCAS personnel witnessed both PIA and integration tests. The second SWS integration was performed on 17 April. Crosstalk tests with the LSM and PS experiments were run on 21 April. The SIDE was not available for these tests. The experiment was returned to JPL for additional testing at the end of April.

1.2 Pre-Integration Acceptance Tests

The PIA test for the SWS experiment is fairly straightforward, and will normally require less than two hours to complete. The first PIA was run without the high voltage inhibit plug and at ambient pressure. Without the inhibit plug, the high voltage for the two highest proton energy levels is disabled and the current profile is thus somewhat reduced (approximately 50 mA). The dust cover removal command may be executed at will at ambient pressures without actual operation. The heating element cannot achieve proper temperature due to conduction and convection. The second PIA was run at 10^{-4} torr with the inhibit plug inserted. In this mode of operation, the tests are usually completed without execution of the dust cover removal command to avoid actuation of the mechanism. The vacuum is removed at the end of testing and the execution of the command at that time completes the test. The second PIA was performed in this manner.

No significant problems were encountered during the SWS PIA tests. Turn-on and dust cover removal current transients and the digital data line is examined with the oscilloscope. Functional tests of the experiment complete the test. EMI problems appeared to be present in the ETS. During the only demonstration of the dust cover removal mechanism, in vacuum, the command was unintentionally executed by the turn-off of paper tape punch. This circuit has since been modified by JPL.

The sequence counter in the ETS periodically miscounts. This problem has been seen once since the modification for the punch EMI and occurred during normal operation. Calibration data agreed closely with that obtained during factory acceptance tests at EOS for all tests run at BxA. Occasional glitches of 2-3 counts were noted. Data provided for minimum and maximum deviation from the calibration points was not correct and resulted in numerous "out of tolerance" points on the second PIA.

1.3 Integration Tests

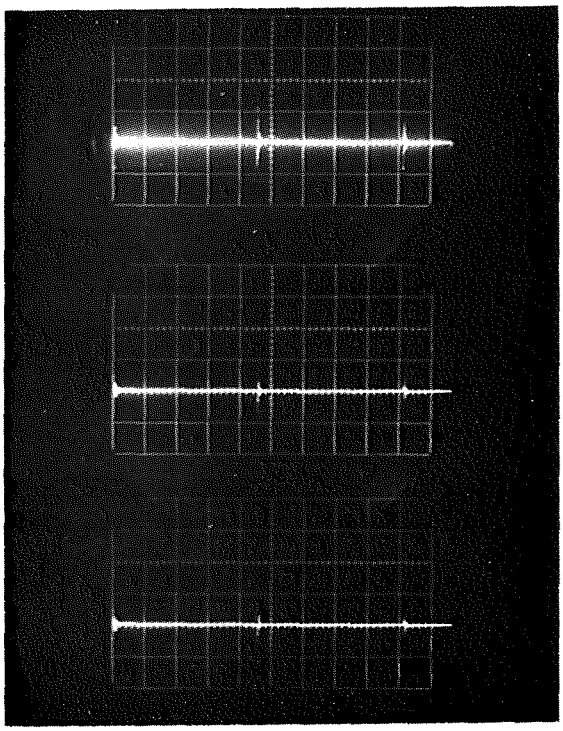
The integration tests for the SWS were also performed quite smoothly. Again no significant problm areas were noted. Of the three EM test discrepancies noted in ATM 618, only power line noise remained as an out of tolerance spec condition. Noise from the converter was greater than 400 mV peak to peak. Figure 1.3.1 depicts the noise photographed during subsystem tests. Noise on the timing and control and command lines not noted on the EM SWS was documented. For reference purposes, Figure 1.3.2 depicts noise created by the Central Station Data Processor with the SWS off line. Figure 1.3.3 depicts the shift pulse line with SWS converter noise of 300-400 mV of noise. The same type of noise is present on the data line as noted in Figure 1.3.4.

Shift pulse crosstalk was noted on the command line. This type of noise is shown in Figures 1.3.5 and 1.3.6. Further investigation is under way to determine the source of the noise. Current noise was noted and di/dt of 200×10^6 milliamp/millisec was measured. This value, along with similar values measured on other experiments during EM testing indicates a more realistic specification greater than the 500 milliamp/millisecond spec value is in order. Figure 1.3.7 depicts typical current noise photographed during subsystem tests.

Current noise which appears to be associated with the shift pulse was noted during investigation of the SWS turn-on. Figure 1.3.8 depicts the noise which will be investigated further. Finally, the turn-off voltage transient was recorded at approximately 60 v peak to peak in Figure 1.3.9.

1.4 Crosstalk Tests

Crosstalk tests were performed on 21 April with LSM and PSE. A dummy load was used in place of the SIDE. Basically this test consists of operating all experiments through all modes of operation while investigating interaction between subsystems. Again the SWS performed well in comparison to other experiments. Data reduction appears to be a major problem, particularly if an experiment is not functioning as advertised. Comparatively little effort was required to determine that the SWS performed without noticable difference during these tests in comparison to the PIA and integration. Even so, this process may be accelerated for the SWS in future tests by elimination of the mathematical analysis from the STS printout via a program option. Elimination of the analysis and printout of an "error" only appears to be a sensible method of reducing "miles" of tape to "feet".

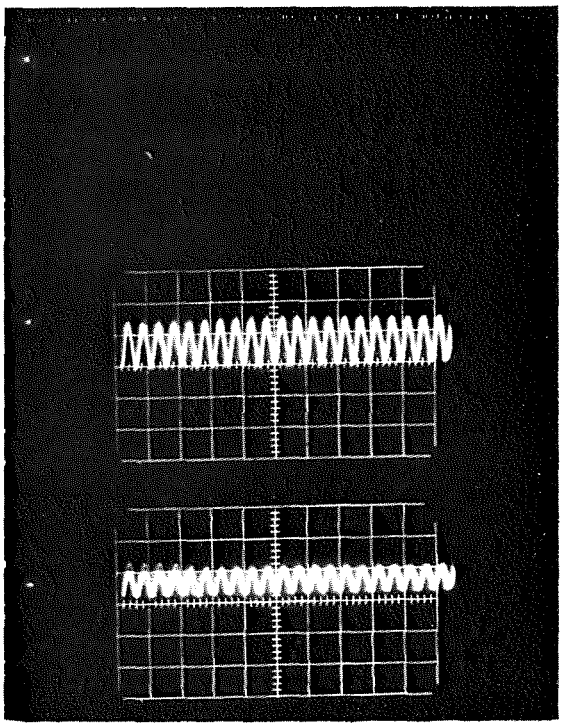


200 MV/CM

50 US/CM

Out of
Spec. Cond.

Figure 1.3.1 SWS +29 V Power Converter Noise



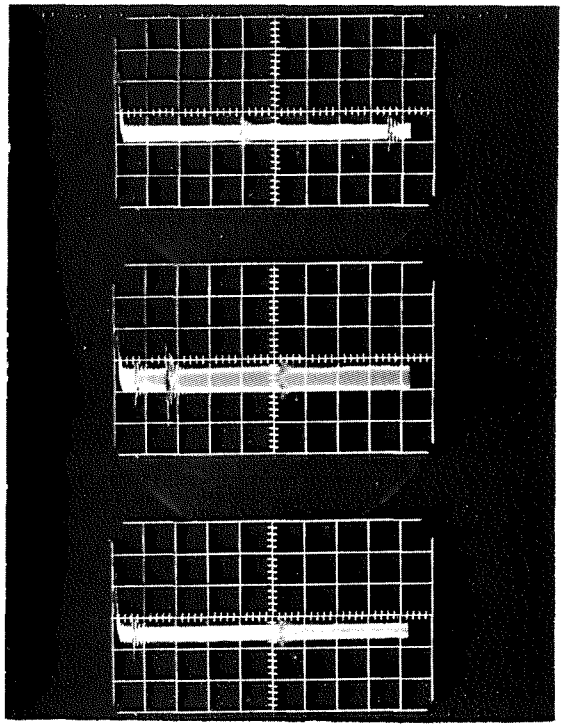
Information
Only

1 US/CM

100 MV/CM

200 MV/CM

Figure 1.3.2 Noise on Shift Line without SWS on Line

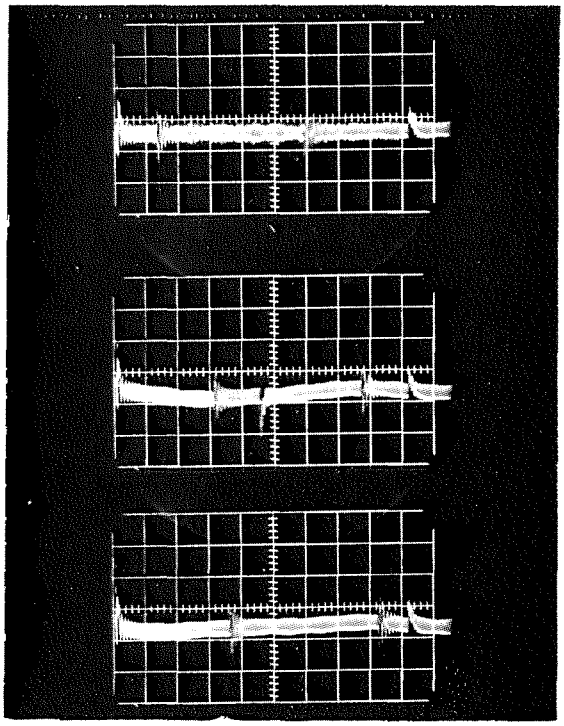


50 US/CM

200 MV/CM

Information
Only

Figure 1.3.3 SWS Shift Pulse Noise

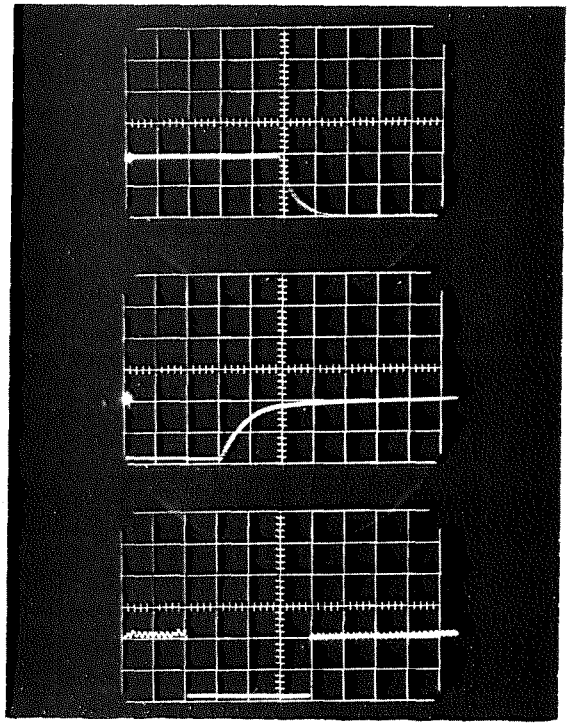


Information
Only

50 US/CM

200 MV/CM

Figure 1.3.4 SWS Data Line Noise



2 V/CM

5 US/ CM

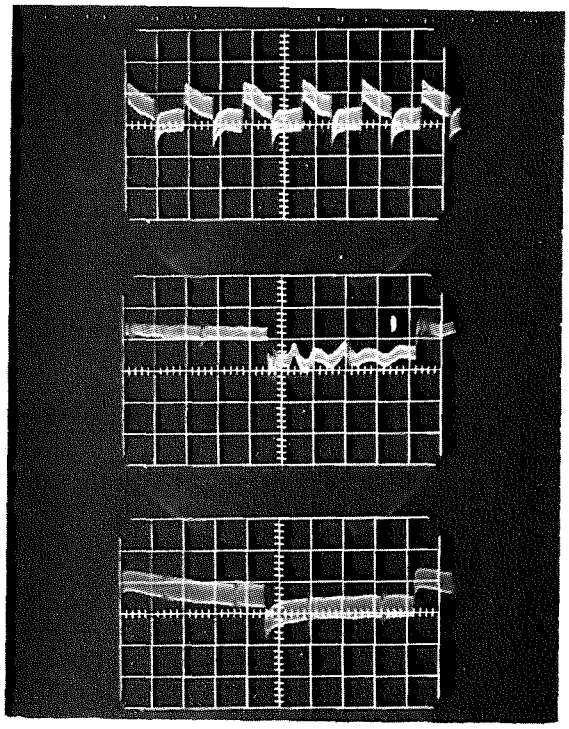
Information Only

10 US/CM

5 US/CM

Figure 1.3.5 SWS Command Pulse, Rise & Fall Time with Shift Pulse Noise

200 MV/CM



500 US/CM

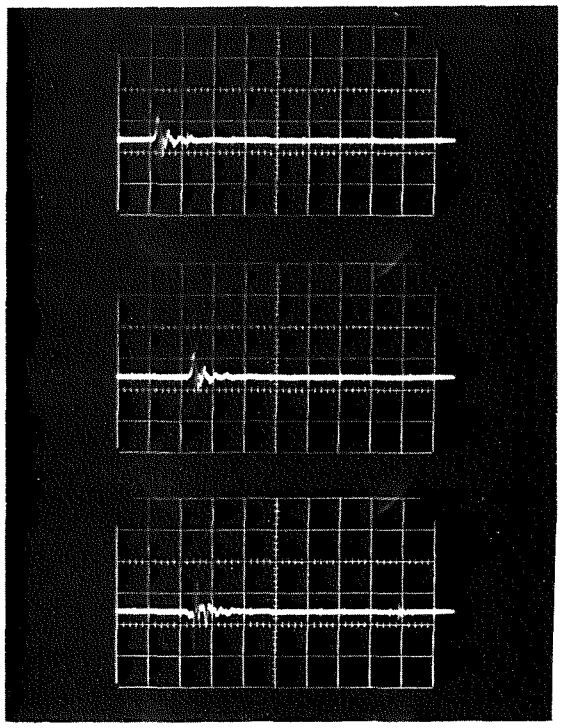
See Table Item # 3

100 US/CM

100 US/CM

DC Coupled Scope Probe

Figure 1.3.6 SWS Command Line Noise From Shift Pulse



50 MA/CM

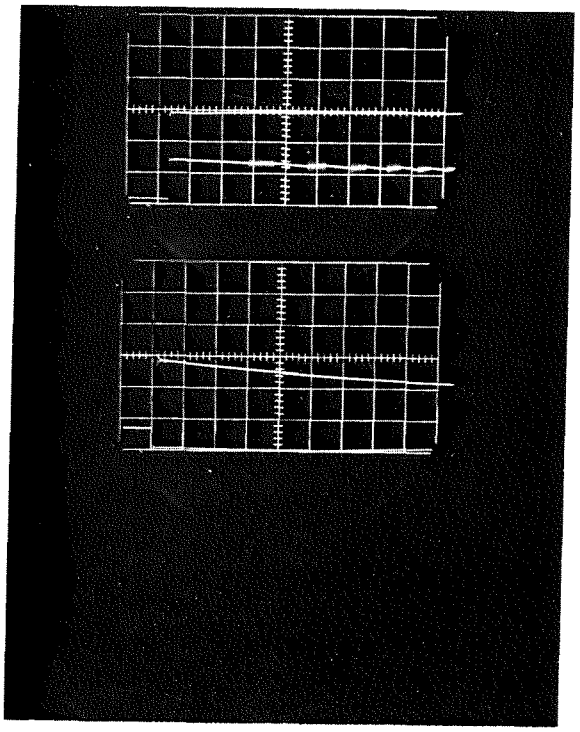
5 MS/CM

Information
Only

Figure 1.3.7 29 V Current Noise

Turn ON

Turn OFF

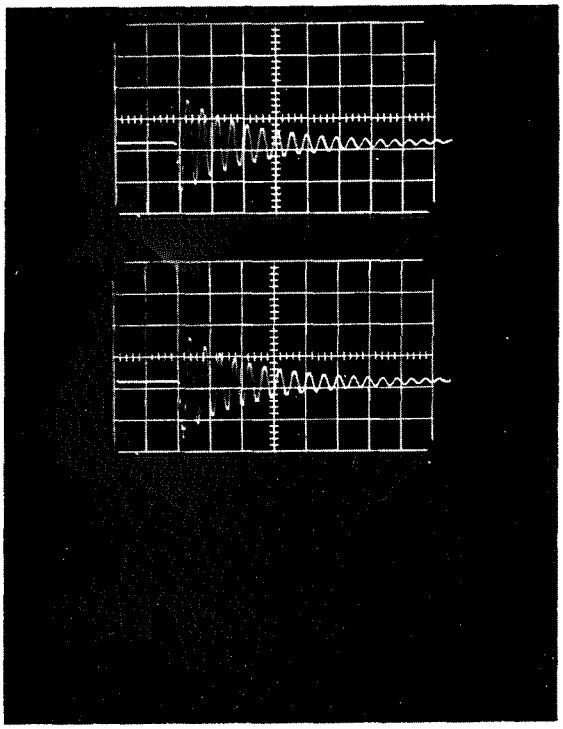


2 MS/CM
10V/CM
200 MA/CM

Information
Only

Note Shift Pulse
Current Noise
During Turn-On

Figure 1.3.8 SWS Turn ON/OFF Voltage and Current Waveforms



20 V/CM

50 US/CM

Information
Only

Figure 1.3.9 SWS Turn-Off Voltage Transient

2.0 LUNAR SURFACE MAGNETOMETER EXPERIMENT

2.1 General

The LSM was the second prototypeexperiments to be delivered to BxA. The PIA was performed on 18 April. The Proto LSM was not fully operational. Several of the problems which were included in the EM were present. When delivered the specified problems were:

a) Z sensor channel inoperative; the Y sensor output was tied to Z data processor.

b) Site-Survey not operational

c) Digital Filter not operational; Filter status OK however

d) The magnetic sensors were capable of flipping with the LSM arms partially deployed (for flux tank operation). This adjustment was critical, and manual assistance was required periodically during tests at BxA because of low torque.

e) External hand wire between EGFU to Y axis sensor. External hand wire bypasses X axis arm connector.

f) No passive thermal control components.

g) Internal electronics not to flight configuration

h) Accuracies not to flight specification, i.e., science and engineering data

i) Out of spec power profile

j) Several mechanical discrepancies. i.e. weight and size

The LSM was integrated to the Central Station electronics on 20 April. Crosstalk tests were performed on 21 April with the SWS and PS experiments. A dummy load was provided for SIDE during these tests.

2.2 Pre-Integration Acceptance Test (PIA)

The PIA on the magnetometer was lengthly and as a result will require extensive modification. The procedure was modified from the Philco Acceptance procedure which apparently is also being modified.

Discrepancies noted as a result of the PIA were:

a) Gimbal position cannot initialize i.e., X, Y, Z ± 90° instead of presite condition of 0°.

b) Cannot null out Earth's field using Helmholtz flux tank coils. The solenoid coil was required to obtain a mid scale science output.

c) Non linear science output i.e. 50 gamma on 100 gamma range was not 50 gamma on 200 gamma range.

d) DVM on ETS not isolated from power supply grounds.

d) Manual assistance required to flip motors at times.

f) Periodic glitching of ETS displays, Status change of experiment noted once.

g) Current ripple for frequencies greater than 250 HZ was approximately 300 MA peak to peak. (measured visually during PIA)

h) Z offset sequence not correct. Positive offsets missing.

i) Status lamp display during flip on X axis status responded in Fail Mode. Required manual set on toggle switch to clear.

j) Low Frequency Current ripple greater 300 MA peak to peak during Flip. (measured visually during PIA)

k) Peak power during flip:

X & Z sensor = 520 MA
Y sensor = 500 MA

This condition was indicated verbally but not included in data package.

l) During Flip Cal (4th Cycle) both phases of Flip Motor failed to energize on Z axis.

m) Engineering data for level status could not be tested since LSM operated in flux tanks only (on side).

Of the 24 discrepancies listed in the March 1967 EM Test Report (ATM 626) 13 remained in the Prototype and were recognized during PIA. Others were found during integration.

Significant changes included a reduction of the turn on current surge to approximately 300 MA. All previous tests required a 50 ohm series surge suppressor to allow turn-on.

The cal-raster from the ETS Analog output was clean. This is partly the result of by-passing the digital filter since less noise was noted during EM tests with the filter out. Noise susceptibility appeared improved.

Current glitches on the current record were only noted once during the PIA. This indication proved false during integration tests and resulted simply because no effort was made to induce noise during PIA. Status information particularly during Flip Cal appeared improved with no know glitches, again because no noise was induced. Flip Motor Current was below that advertised. During PIA, peak currents of 520 MA were measured. Recordings by Ames indicated peaks as high as 570 MA. Some doubt existed as to whether the Flip sequences could be performed since the LSM Central Station circuit breaker tripped at 537 MA.

In general, the LSM Prototype appeared to be very similiar to the EM with exception of the turn-on transient and stability of data.

2.3 Integration Tests

The Integration tests ran smoother than the PIA since it is basically less complex. The operation of the LSM waserratic from the start of the test On initial turn-on, the LSM Status display, (feed via buffered timing, control* and data signals from the signal breakout box) hung up. Three separate turn-on commands were required to turn the experiment on satisfactorily. In the "hung up" mode, the LSM engineering sequence stops resulting in a continuous output of LSM word 1 with 1's in the status and engineering slots; that is ALSEP word 5 is all 1's and does not change. The six science words (ALSEP) appeared normal although when checked, the data did not change because of supposedly steady input conditions. Several times during the tests the experiment reverted back to the "hung-up" condition. This condition was not similar to that noted during EM tests.

Erratic operations of the Status display on the ETS during the first half of the integration and corresponding changes in output in the STS printer was very similiar to the normal operation noted throughout the EM tests. Partway thru the test correlation between the LSM jitter and changes in chart speed of the Sanborne strip chart recorder was noted. The recorder chart speed was secured for the duration of the test. The command sequence to the point in the procedure was repeated. The test procedure was then completed in straight forward manner with results similar to the PIA.

* The ESTS was operated during integration tests for the benefit of Philco and Ames respresentatives.

Data reduction proved to be impossible for portions of the STS Printout which corresponds to the unstable operation of the experiment. The start of the test was reviewed to look at conditions during the "hung-up" condition. The portion of tape during the unstable operation was not analyzed. The remaining portion of the tape, approximately one hour of operation, required approximately 16 hours to review. It is doubtful if the notes from this review are 100% complete. A portion of the notes during the Flip-Cal sequence are included for information. It would be optimistic to assume data reduction will be reduced with a fully functional experiment. It must be pointed out that site survey was not attempted and is 3 times as complex as the Flip-Cal sequence.

At the conclusion of the integration, the list of discrepancies for the LS or Prototype included:

1) Flip-Cal Power transient : motor power was variable, measured 470-520 MA ICS value 372 MA @ 29 V.

2) Test Set Display Jitter : Jitter was apparent on the ETS display with the experiment and with the LSM simualtor operated in a separate test.

3) Improper Flip Calibrate : Improper sequencing of motor phases was noted during the 4th flip-cal on the Z axis during PIA.

4) Transient on the X, Y, Z Science Data : transients occurred intermittently throughout all tests.

5) LSM not in proper preset condition on turn-on : Cal-Inhibit not in, Pre-site Gimbal position not obtainable.

6) Calibrate Raster from Analog Output of ETS garbled : Jitter in raster appeared to be eliminated, however the Digital Filter was not in operation throughout tests. With the permanent offset to the sensor electronics and non-linear operation, it is possible to determine if the Cal Raster is correct.

7) Permanent offset in Sensor Electronics : Unable to null field with Helmholtz Coil. With solenoid was able to allow mid-scale reading on 400 gamma range.

8) Power ripple inconsistent : Power ripple changes during normal operation.

9) No Z axis Sensor Electronics

10) Engineering Data for words 4 and 12 unstable : Switches from 000-127, i. e. full scale oscillation.

11) Y and Z Data changed sign intermittently : Both channels tied together - change should not occur

12) Z offset cycle incorrect : offset sequence contained no positive offsets.

13) Engineering Data 16 Frame Sub Commutator stops, skips and jumps intermittently : occurred throughout tests - appears associated with science data glitches.

14) Logic and Power Switching unduly sensitive to EMI.

15) Channel 7 Engineering Data Jitter : Throughout test data shifted 1 Bit from 010 to 011.

16) Current ripple during flip cal with motors energized was greater than 75 MA for frequencies over 250 HZ. See figure 2. 3. 10.

17) Noise on the command and shift pulse line exceeded 100 MV peak to peak : up to 150 MV recorded, see figure 2. 3. 6.

The turn-on voltage and current waveform is shown in Figure 2. 3. 1. This waveform had not been recorded previously since a 50 ohm surge supressor had been employed during turn-on previously. Figure 2. 3. 3 shows the Digital data waveform from LSM. Noise on top of the wave form was similar to the EM. Power Converter Noise was greater than that seen on the EM. Figure 2. 3. 3 thru 2. 3. 7 depicts this noise. Current ripple during normal operation is shown in Figure 2. 3. 8 for comparison with the Flip-Cal Motor Current Ripple shown in Figure 2. 3. 9 and 2. 3. 10. This ripple is greater than th the 150 MV peak to peak (across a 2 ohm resistor) value specified in revision C of the ICS.

NOTES FROM STS PRINTOUT LSM INTEGRATION 4/20/67

Time	Count	LSM Frame	Status Data	Eng. Data	Science Data X	Y-Z	Remarks
7:29:39	1367	1	11	127	+497	+497	Prior to second Flip Cal
	1368	2	11	003	+497	+497	
	1369	3	10	067	+497	+497	
	1370	4	00	127	+497	+497	
	1371	5	11	003	+497	+497	
	1372	6	11	018	+497	+497	
	1373	7	11	010	+497	+497	
	1374	8	11	107	+497	+497	
	1375	9	01	127	+497	+497	
	1376	10	10	003	+497	+497	
	1377	11	11	067	+497	+497	
	1378	12	01	127	+497	+497	
	1379	13	11	003	+497	+497	
	1380	14	00	018	+497	+497	
	1381	15	00	011*	+497	+497	
	1382	16	00	107	+497	+497	
	1751				997-411	+497	Execute Flip Cal.
	1752				393-395	+497	
	1755	13	10				Cal ON.
	1767				401-395	+497	
	1768				433	+497	
	1783				439-469	+497	
	1889				497-413	+497	
	1915				403-431	+497	
	1931				439-471	+497	
	2025	13	11			+497	Cal. OFF.
	2027				437-195	+497	
	2028				109	+497	
	2029	1	01		109-111	+497	Flip X axis to0°
	2037				167-423	197-159	
	2038				497	175	
	2046	2	01				Flip Y axis to0°
	2047	3	00				Z axis to not pos
	2057	13	10		497	151	Cal. ON.
	2111				497-203	143-177	
	2112				141-147	181	
	2127				163-235	187-217	
	2143				249-267	225-255	
	2159				245-125	245-199	
	2175				165-475	139-167	

Time	Count	LSM Frame	Status Data	Eng. Data	Science Data X	Science Data Y-Z	Remarks
	2176				497	173	
	2249				497-203	141-175	
	2250				141-147	181	
	2265				163-255	185-217	
	2281				249-269	225-255	
	2307				245-125	245-149	
	2308				101-081	129-105	
	2311	13	11		077	101	Cal. OFF
	2543	1	01	127	079-103	105-133	Cal #3 initiate
	2544	2	01	003	107	137	
	2545	3	00	067			
	2551				165-473	141-169	
	2552				497	175-173	
	2555	13	10				Cal. ON
	2625				497-203	141-175	
	2626				143-147	181-179	
	2641				163-235	185-217	
	2657				249-269	225-255	
	2673				247-123	245-149	
	2689				165-475	139-169	
	2700				497	173	
	2763				497-203	143-175	
	2769				143-147	181-179	
	2779				163-235	185-217	
	2805				251-269	225-255	
	2821				245-125	245-149	
	2825	13	11		111	141	Cal. OFF
	2828				123-287	139	
	2829	1	01		317-315	139	X axis to NOT
	2831				315-475	137	
	2832				497	137	
	2837				497-413	137-085	
	2839				397	075-021	
	2840				397	375-497	
	2845	01	11		395	497	X axis to 180°
	2845	02	11				Y axis to 180°
	2847	03	10				Z axis to 90°
	2853				403-431	497	
	2857	13	10				Cal. ON
	2869				441-471	497	

Time	Count	LSM Frame	Status Data	Eng. Data	Science Data X	Science Data Y-Z	Remarks
	2975				497-415	497	
	3001				403-431	497	
	3017				441-471	497	
	3111	13	11		497	497	Cal. OFF

* Status & Engineering changes of ± 1 LSB marked by *. Tolerance placed on Science Data ± 25 octal increments (approx. ±5%.) i.e. STS does not print unless science data shifts greater than ± 25.

2.4 Crosstalk Test

No significant difference in operation from that seen on the Integration tests was noted during Crosstalk tests. It should be noted that it is very difficult to determine if crosstalk problems exist with this experiment since periodic glitches and slippage of status and engineering data occur when the experiment is operating by itself. The experiment appeared to settle down after approximately one hour operation. Prior to that the science and sequence counts were interrupted by the above noted transients about 12 times. The glitch of science data to -511 and slippage of the LSM sequence count with respect to status and engineering data appears to be interrelated. A second group of transients occurred near the end of the test sequence after stable operation for about one hour. The final half hour operation contained several transients.

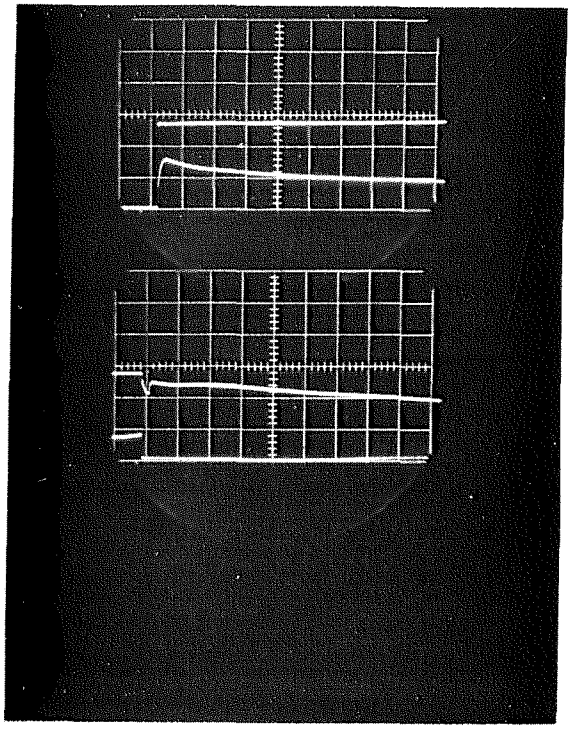
The experiment did not appear to be overly sensitive to any particular series of commands. No attempt was made to analyze the science data during this test.

2.5 LSM Simulator

The LSM Simulator was integrated to the prototype central station on 25 of April. Operation of the simulator for approximately one hour appeared normal in all respects. The tolerance set for status, engineering and science data was ± 1 LSB. No errors or changes in data were noted on the STS printout.

Turn ON

Turn OFF



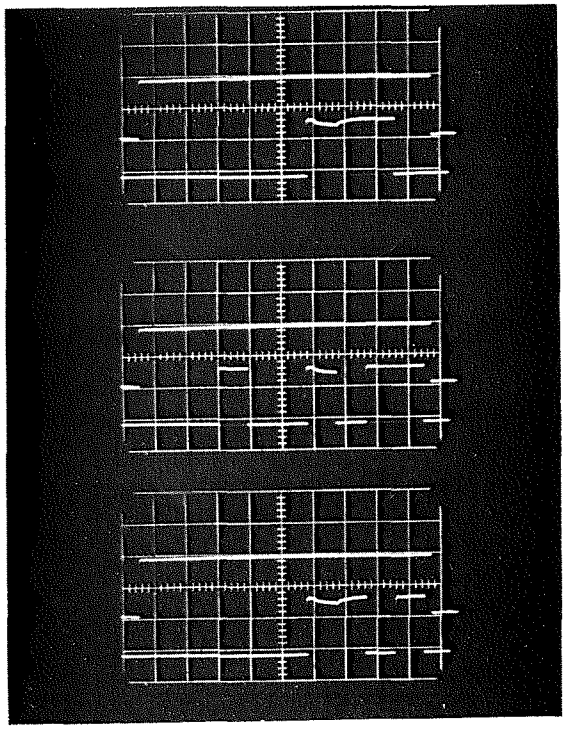
10 V/CM
200 MA/CM
2 MS/CM

Zero Current at Bottom of GRID.

Information Only

Figure 2.3.1 LSM Turn On/Off Voltage & Current

2 V/CM
1 MS/CM



Demand and Data All Photos

Information Only

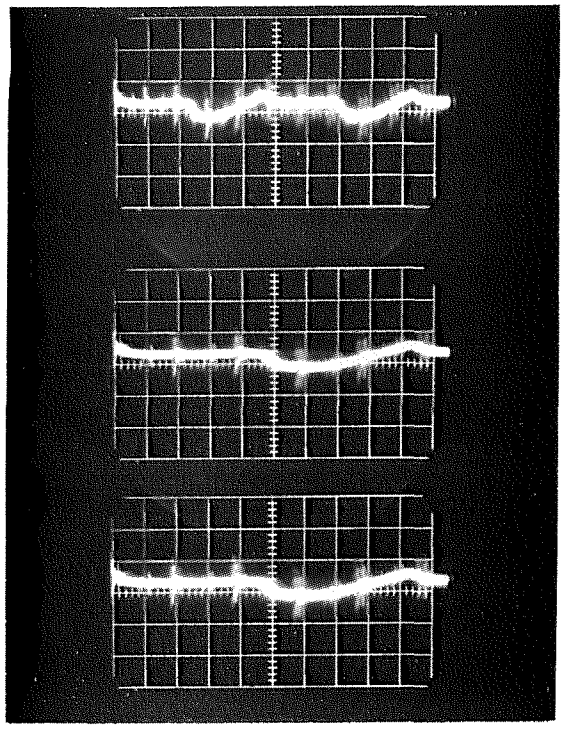
Note Noise on Data

Figure 2.3.2 LSM Demand & Digital Data Signals

200 US/CM

10 US/CM

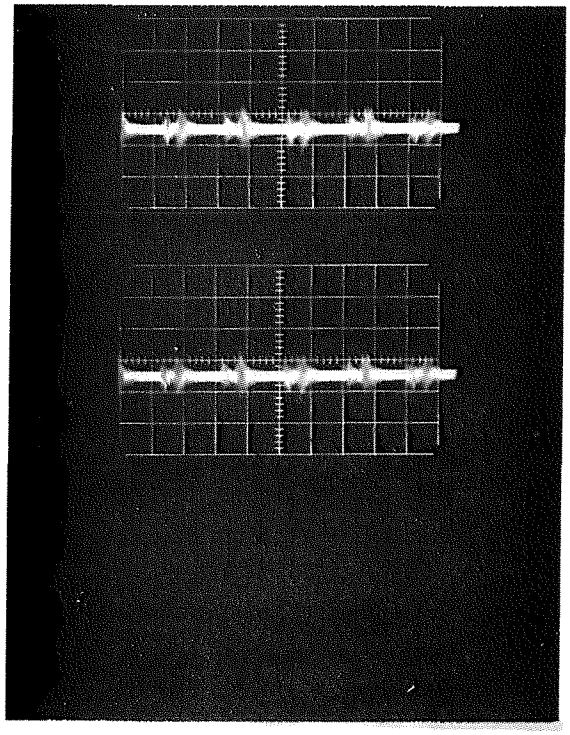
10 US/CM



100 MV/CM

Out of Spec

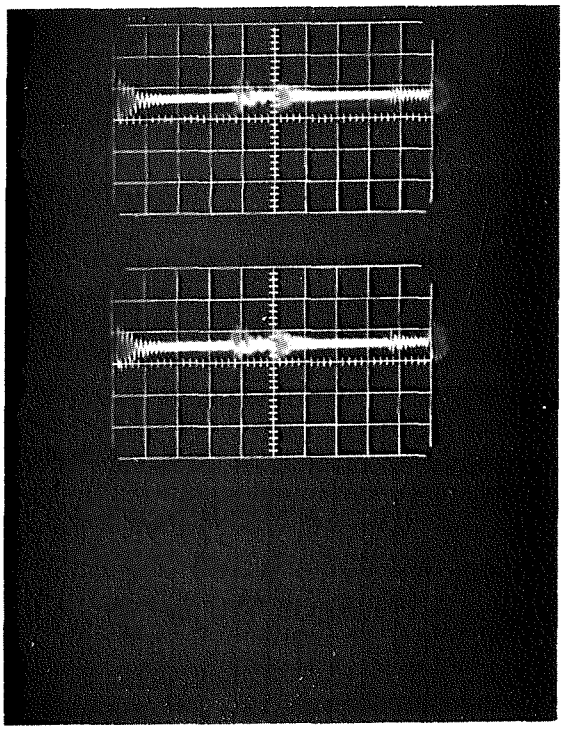
Figure 2.3.3 Power Line Noise



100 MV/CM
5 US/CM

Out of Spec

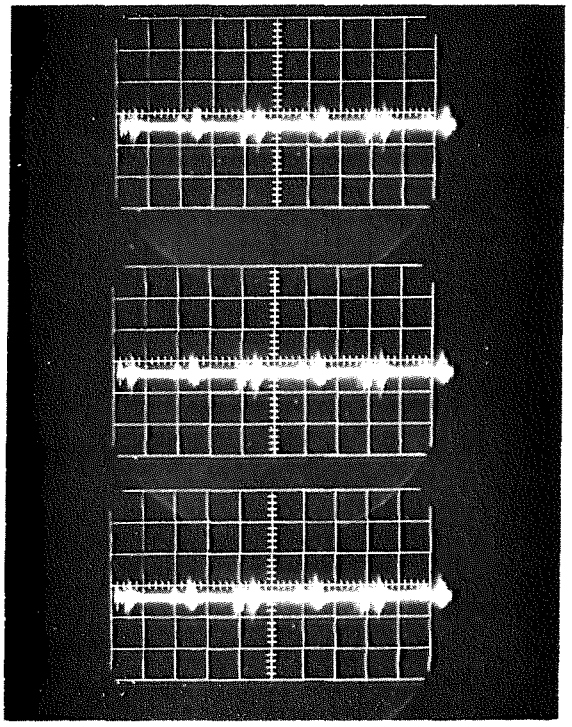
Figure 2.3.4 Data Line Noise



100 MV/CM
2 US/CM

Out of
Spec

Figure 2.3.5 Shift Pulse Noise



Range Select

Steady Field
Offset

Offset Ratchet

100 MV/CM
5 US/CM

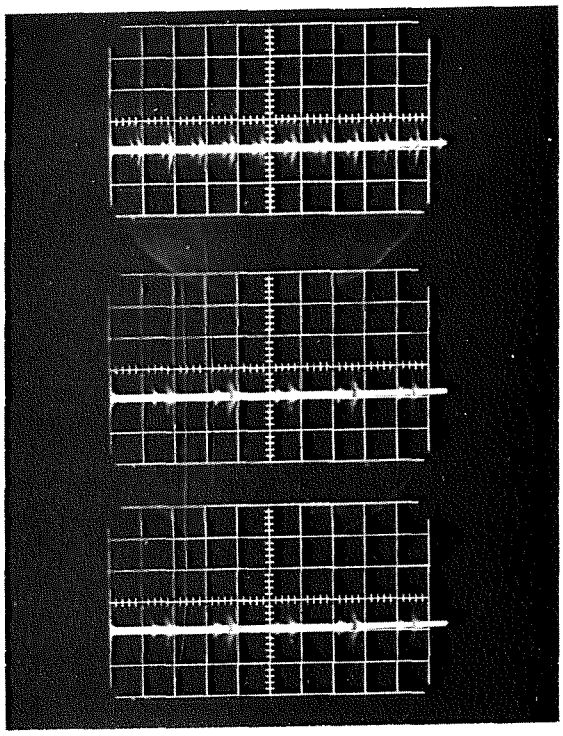
Out of
Spec

Figure 2.3.6 Command Line Noise

10 US/CM

5 US/CM

5 US/CM

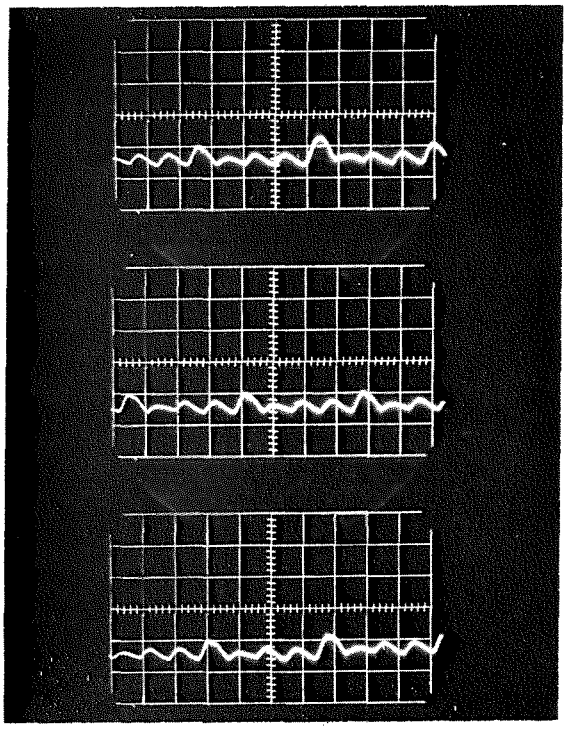


100 MA/CM

Zero at Bottom of GRID.

Information Only

Figure 2.3.7 + 29 V Current Noise



100 MA/CM
10 MS/CM

Information Only

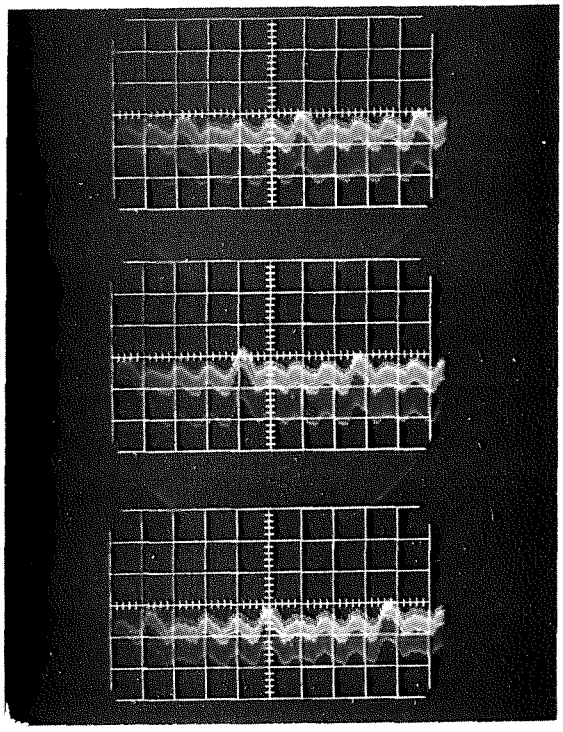
Zero at Bottom of GRID.

Figure 2.3.8 +29 V Current Ripple Normal Operation

X Axis

Y Axis

Z Axis



100 MA/CM

10 MS/CM

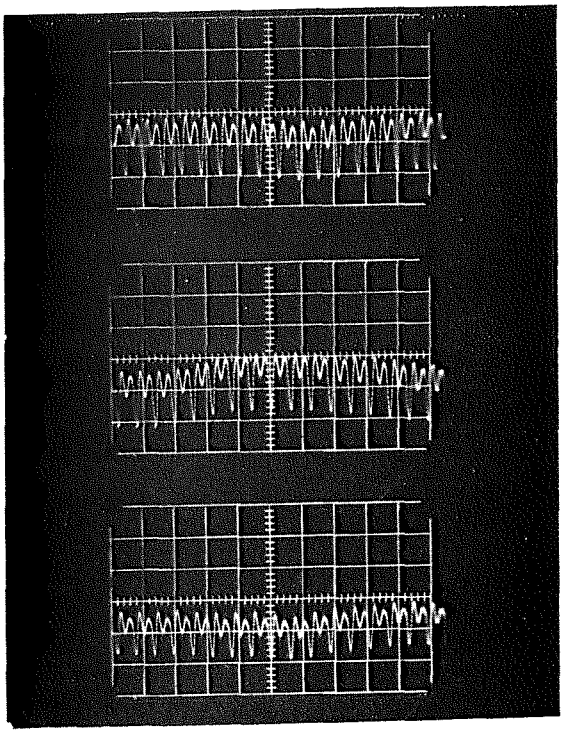
Out of Spec

Figure 2.3.9 Flip-Cal Motor Current Ripple

X Axis

Y Axis

Z Axis



100 MA/CM

1 MS/CM

Out of Spec

Figure 2.3.10 Flip-Cal Motor Current Ripple

3.0 PASSIVE SEISMIC EXPERIMENT

3.1 General

The Pre-Integration Acceptance Procedure (PIA) was performed on the evening of 18 April. Integration was performed on the 19th. Documentation was finished on the 24 of April

3.2 Pre-Integration Test

The PIA for PSE was performed smoothly. Procedures were modified at the last moment because of new information regarding the experiment. Not all responses measured during the test were explained prior to the test itself, particularly with regard to interface with the PSE Sensor and exciter. Additional problems as a result of the tests were:

a) Thermal Control response was correct on the first try but failed to sequence thru all four steps on additional attempts. The status cycled between two levels.

b) SP-Z channel did not respond to the exciter signal. The problem was believed to be associated with the ETS since the EM SP channel did not respond to SP Test signals either.

3.3 Integration

Integration of the PSE was performed in a manner similar to that of the other experiments. The power drained, timing and control, and status signal appeared correct during initial phases of the test. The science data output did not appear proper. Distortion was present on the SPZ & LPX, Y, Z channels and also was present on the tidal channels.

The problem was believed to be in the set-up of the optical strip chart recorder. Playback of the magnetic tape after the conclusion of the test proved the problem to be a noisy D/A converter in the STS.

As a result of not having the real time display, via optical recorder, some data was lost since some commands were executed during recovery of the experiment signal levels. These levels were disturbed by the Sensor Exciter Master Reset function and require approximately 40 seconds to recover.

Several problems of interpretation of experiment data were encountered during experiment integration. Many of these problems will be cleared up when the data is reviewed with Teledyne personnel. This review will be conducted starting May 15, 1967 at Bendix. A list of items for review follows:

a) SP-Z offset was at 3/4 scale or approximately 3.7V. LPX, Y, Z appeared to operate normally at mid-scale i.e. 2.5V.

b) Levels on LPX, Y & Z and their respective tidal outputs require definitions.

c) Instrument temperature made periodic unexplainable steps approximately 3/4 scale. The steps were accompanied with transients on LPX, Y & Z and tidal channels.

d) There was no response to LPX & Y gain change in either the science or housekeeping data.

e) Expected amplitude for given exciter outputs are not available. Signal amplitudes are unexplainable in terms of D.B.

f) Change gain SP, first command, saturates the science channel. The channel recovers on the 4th command to "normal" 3/4 scale. Interaction with LP X, Y and Z are present.

g) Proper response to LP & SP Cal is unknown.

Noted response was approximately a IV transient with a 40 second recovery.

h) No output signal of significance was present on the SP channel. ALl signals were less then 200 MV for 5V full scale.

i) Response to filter feedback command is unexplained.

j) The uncage command creates transients on LP X and tidal X.

k) The thermal control sequence does not sequence properly (noted on PIA)

1) The SP Cal. Command interacts with LP Z; no response was noted on SP-Z.

Interface problems present on the EM and still present on the Prototype are:

a) Power converter noise of greater than 800 MV. Amplitude of noise is inconsistent. Photos showing noise up to 2V p.p. are included.

b) Power converter noise on timing control and analog signal lines.

Problems noted on the EM which have not been investigated to data are:

a) Survival power has not been measured directly. In direct measurement of the shunt regulator current indicates survival power is connected.

b) Trailing dege of the uncage command signal.

c) 29V noise due to the level power switching.

Figure 3.3.1 thru 3.3.3 shows the +29 volt noise measured on two separate days. This problem will be further investigated. PSE power converter noise on the timing, control, command and analog line appears greater than that noted on the EM. The turn-off transient shown in Figure 3.3.8 showed no evidence of a transient. The turn-on current transient contained high frequency components which appear as fog in Figure 3.3.9. Figure 3.3.10 shows the high frequency noise clearer. This noise was of too high a frequency to record.

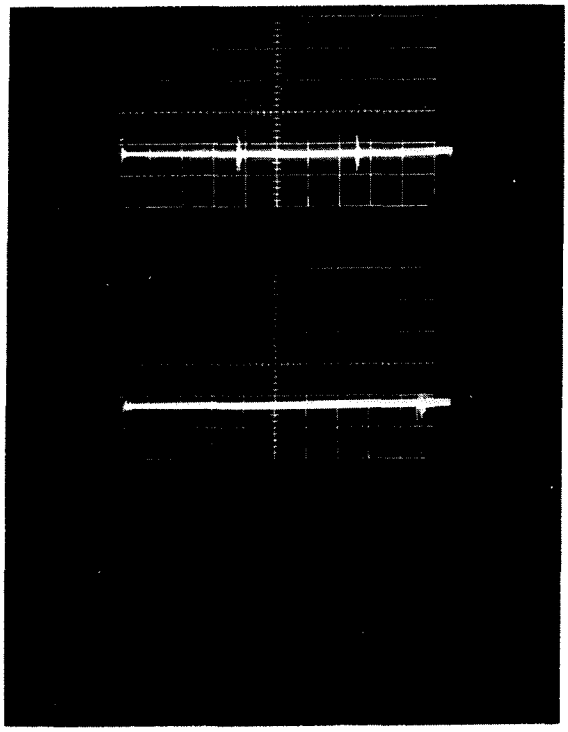
3.4 Crosstalk Test

The PSE Crosstalk Test was performed on 21 April with the LSM and SWS experiments. A dummy load was used in place of the SIDE. No noticeable interactions were noted on the PSE during this test. The PSE Exciter was operated in the reset mode for all tests except for the PSE Command Sequence.

The STS was programmed for the SWS printout. Therefore PSE science data was not obtained until playback of the magnetic tape after the test had been completed. Sufficient time between commands was not taken to produce useful data on the PSE response to its command sequence. This was the result of lack of familiarity with the 40 second transients contained in the experiment and inability to monitor the output in real time.

5 US/CM

2 US/CM



500 MV/CM

Out of
Spec

Figure 3.3.2 PSE 29V Noise, 24 April, After Crosstalk Tests

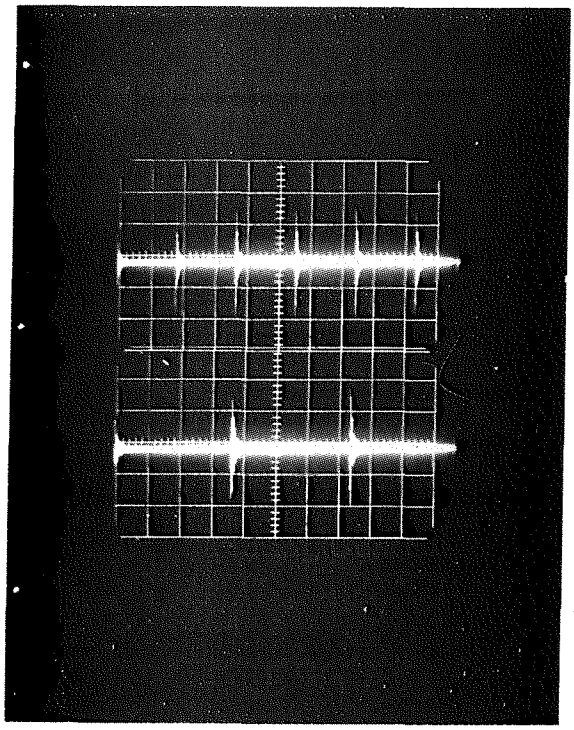


Figure 3.3.3 PSE +29V Current Noise 19 April

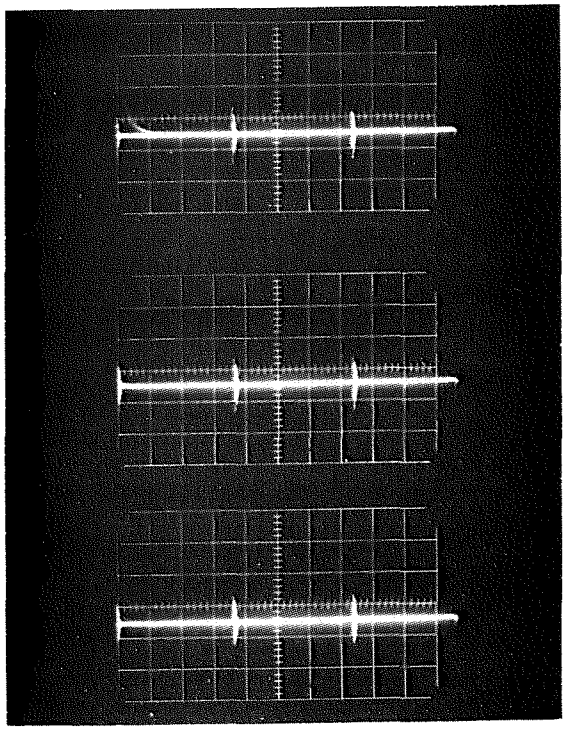


Figure 3.3.4 PSE Power Converter Noise on
Timing Control

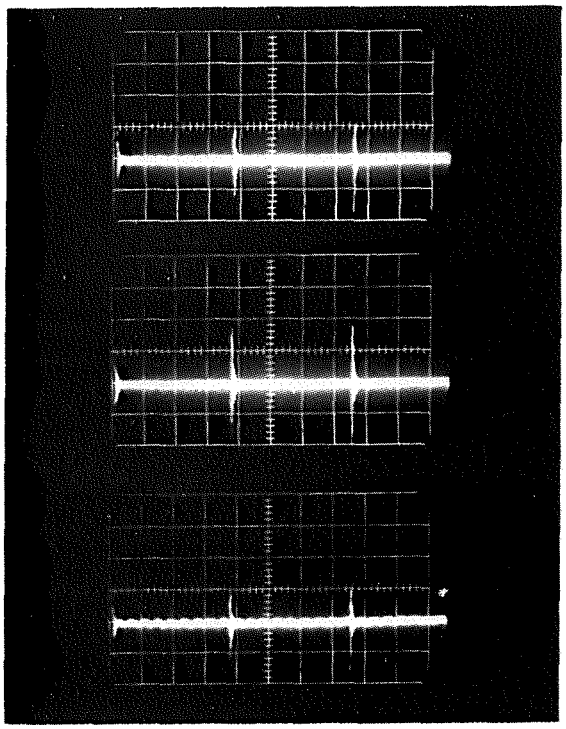


Figure 3.3.5 PSE Power Converter Noise on Analog Lines

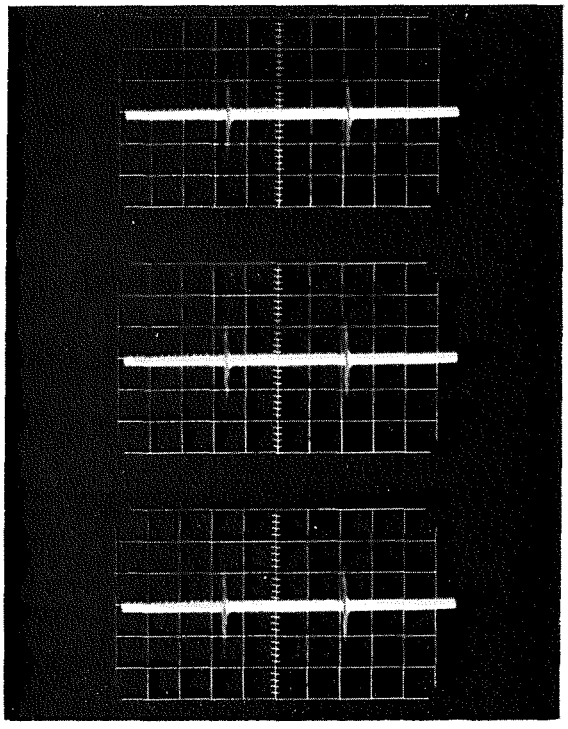


Figure 3.3.6 PSE Power Converter Noise on Command Lines; TP refers to SBOB Test Point

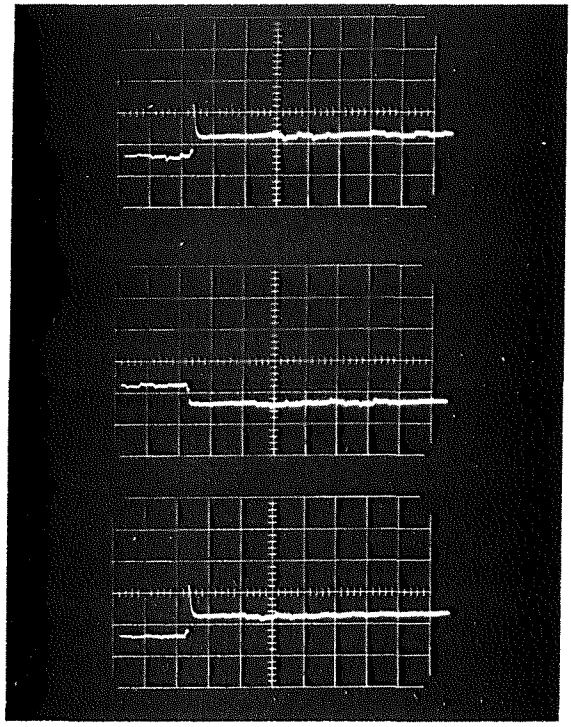


Figure 3.3.7 PSE Level Motor X Current Response on +29V Line

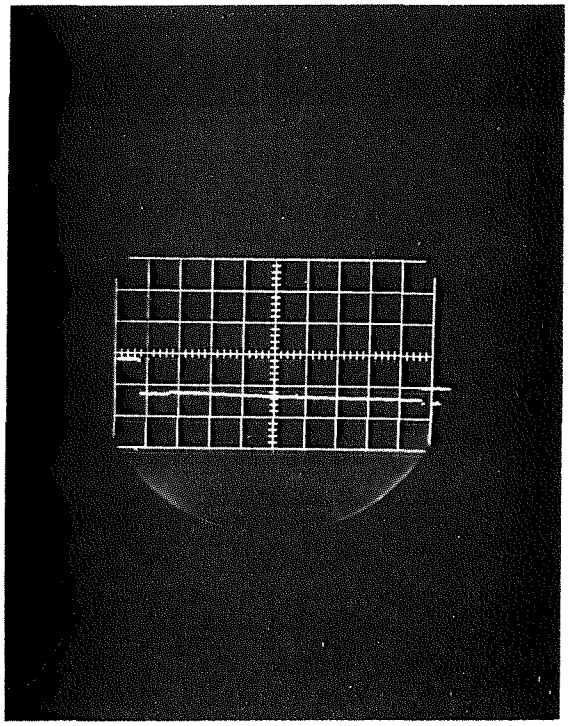


Figure 3.3.8 PSE + 29V Turn -Off Transient

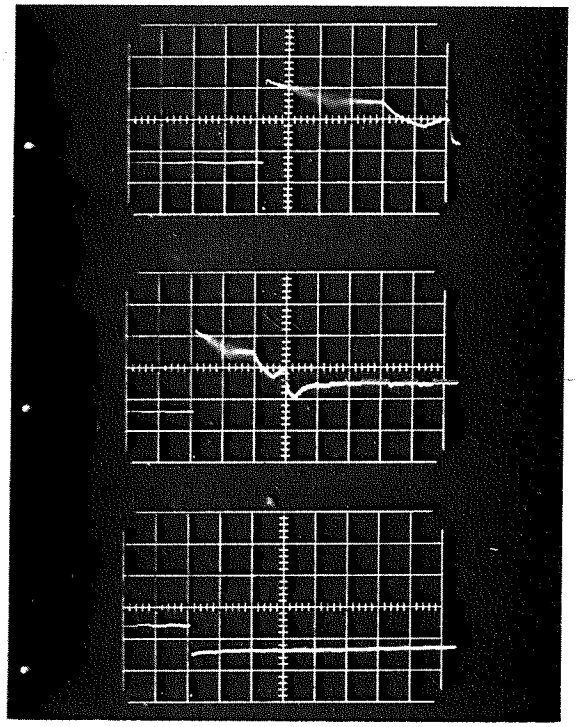


Figure 3.3.9 PSE + 29V Current Turn-On Transient

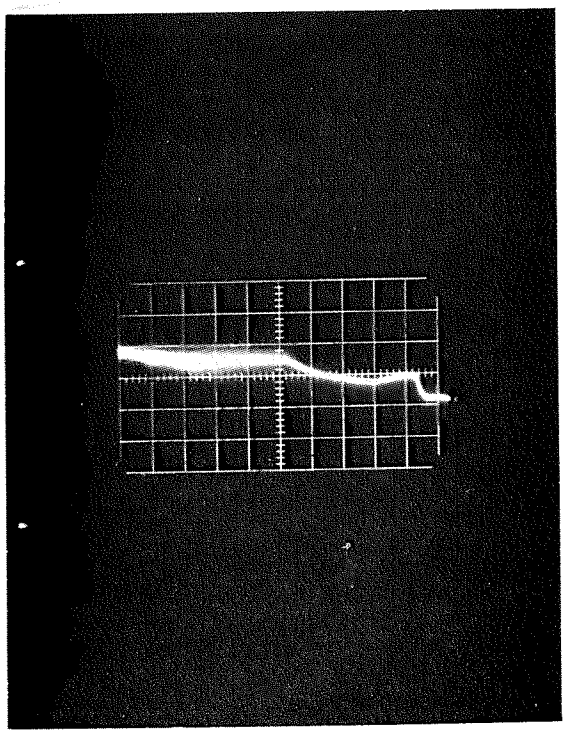


Figure 3.3.10 PSE +29V Current Turn-On Transient

4.0 Cold Cathode Gauge Experiment

4.1 The CCGE began Prototype Test at BxA on 28 April 1967. Both the PIA (Pre-Integration Acceptance) and integration test procedures required changes which could not be corrected in a reasonable time span and it was therefore decided to conduct informal tests to "marked up" procedures. The PIA was completed shortly after noon on the 28th. Integration set-up procedures were under way in an effort to complete the integration test the same day. Probelms arose when a failure was discovered in the Central Station Multiplexer. Tests were delayed over the weekend and were completed on Monday. Documentation was completed by noon on the 2nd of May.

4.2 Pre-Integration Test

No significant problems were noted during this test. Calibration data was not as expected because of what is believed to be a relay failure internally. This failure prohibits the gauge output from being terminated during calibration thus offsetting the calibration. The only other problem consisted of modifying the test procedure itself which was expected on the initial test. Figure 4.2.1 shows the CCGE turn-on current transient photographed during the PIA. This transient contains an extra step shown on the lower photo which is not present when the experiment is connected to the Central Station.

4.3 Integration Test

The CCGE Integration test was performed routinely. No out-of-spec. conditions were noted. Several questionable areas noted during EM tests appeared to have been fixed. These include a current ripple after the Demand Pulse and noise on the timing and control lines. Noise on the data line was approximately 200 MV at the Shift Pulse repetition rate. Measurements were made at 10 US/CM verses 2 US/CM, taken on the EM test. Thus a clear comparison was not made. Much of the noise appeared to be contributed from the Central Station since it was still present with the experiment disconnected. This is not the case with the EM and further investigation will be made. Several photographs taken during integration are provided for information purposes.

Figure 4.3.1 shows the turn-on transient without the step noted during PIA. A resonable explanation for this phenomena is not available without further information concerning the experiment ETS.

The remaining figures are self-explanatory. The turn-off voltages transient appeared to be less than 10V peak to peak. A clear photograph off the transient was not obtained. The Shift Pulse rise and fall photo was taken since clock noise appeared to be high.

4.4 Crosstalk Tests

Crosstalk tests with the CCGE were not performed since only the LSM was available for testing.

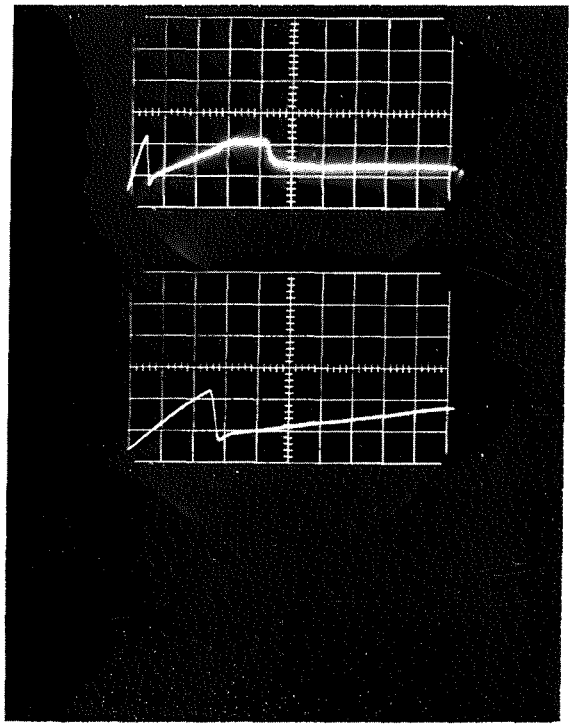


Figure 4.2.1 CCGE Turn-On Current Transient During PIA

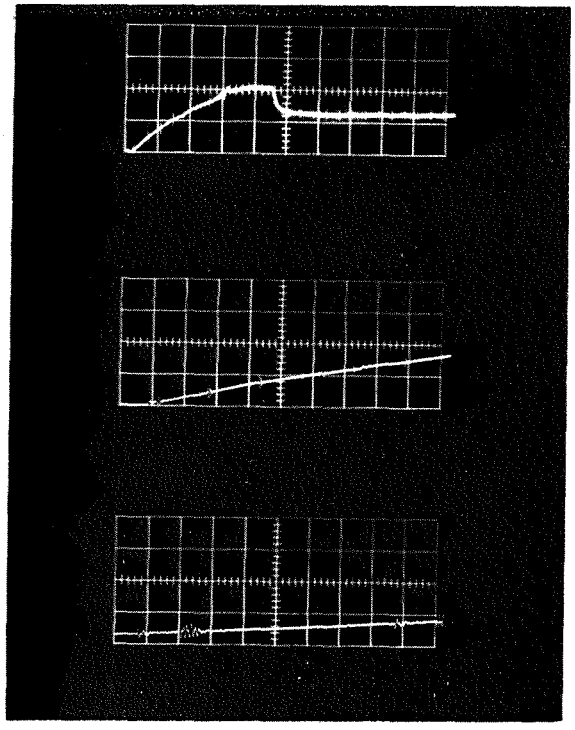


Figure 4.3.1 CCGE Turn-On Current Transient During Integration

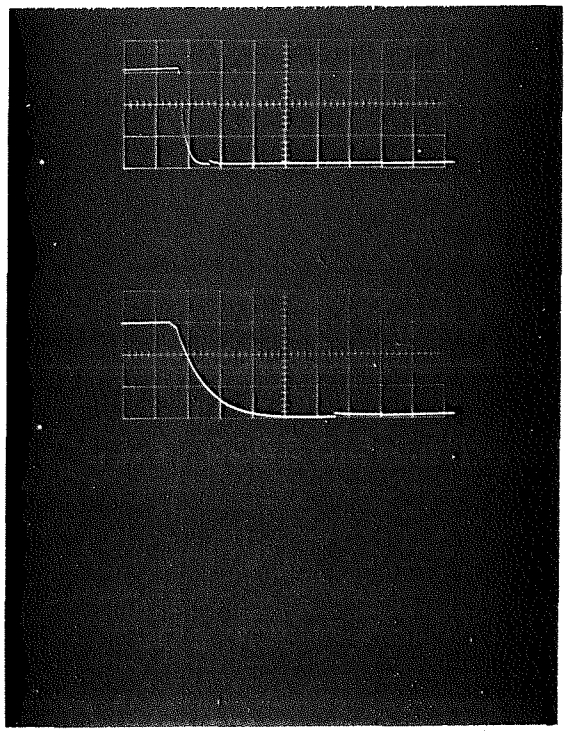


Figure 4.3.2 CCGE Voltage Turn-Off

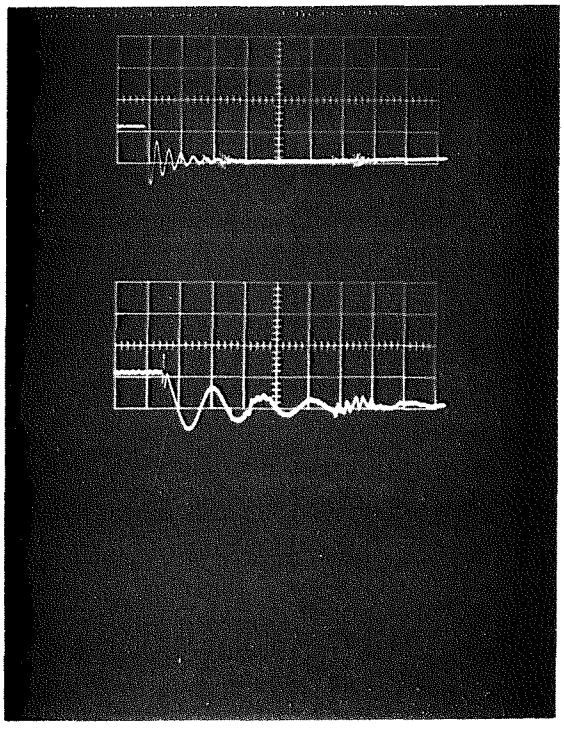


Figure 4.3.3 CCGE Current Turn-Off Transient

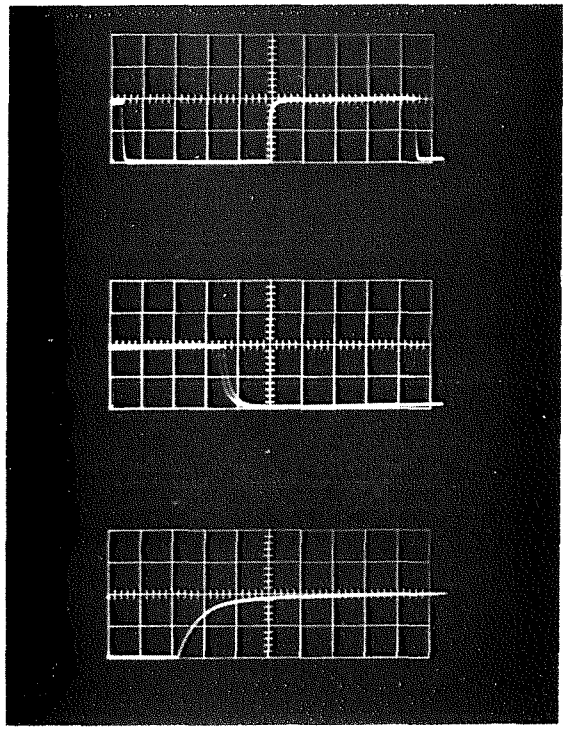


Figure 4.3.4 Shift Pulse Rise & Fall Time

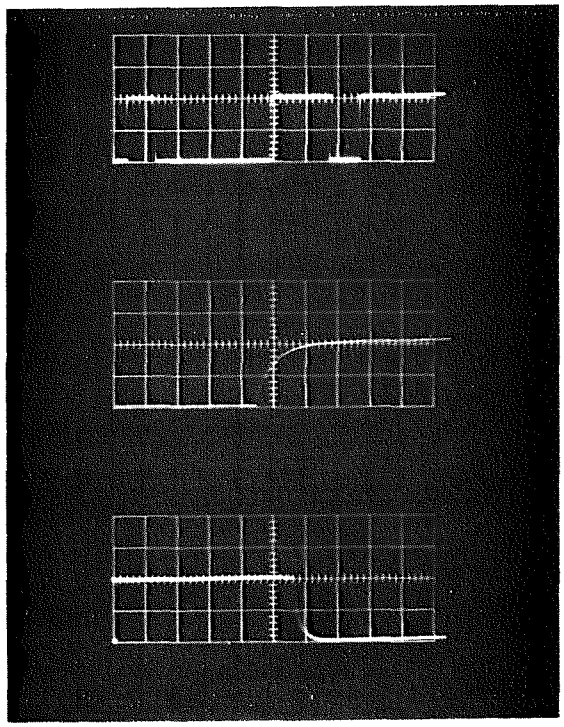
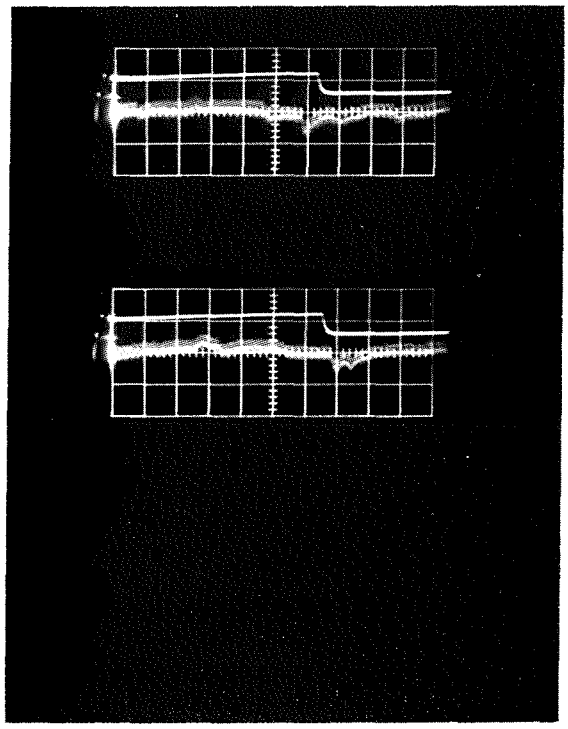


Figure 4.3.5 Data, Rise and Fall Times

5 V/CM
50 MV/CM



20 US/CM

Information
Only

5 V/CM
50 MV/CM

Figure 4.3.6 CCGE Analog Line Noise with Fall of Shift Pulse Housekeeping Channel 85

SOLAR WIND SPECTROMETER EXPERIMENT PROBLEM AREAS

	Problem Area	ICS Para.	ICS Value	Remarks
1.	Sequence Counter in ETS Periodically Miscounts	N/A	N/A	No ICS on ETS. This condition has only been seen once since mod to tape punch.
2.	Power Line Noise	3.2.2.8.6	75mV	See ATM 618 Table 3.3.2.1 Item 2. Noise from converter was greater than 400mV PP. See Figures 1.3.1 and 1.3.2.
3.	Shift Pulse Crosstalk noted on the Command Line	N/A	N/A	No ICS for this condition. Typical spec for this item is 100mV PP. See Figures 1.3.5 and 1.3.6.

MAGNETOMETER PROTOTYPE PROBLEM AREAS

	PROBLEM AREA	ICS PARAGRAPH	ICS VALVE	REMARKS
1.	Flip Cal Power Transient: Motor Power was variable measured 470-520 ma	3. 2. 3	372 ma @ 29V	Para. 3. 2. 3. 3 Flip-Cal move day time operation & night time operation 300 sec max 10. 8 W max
2.	Test Set Display Jitter: Jitter was apparent on the ETS display with the experiment & with the LSM Simulator operated in separate tests.	N/A	N/A	No specs for operation of ETS.
3.	Improper Flip Cal: Improper sequencing of motor phases was noted during the 4th Flip-Cal on the Z axis during P. A.	N/A	N/A	Flip Motor Sequence Not spelled out in ICS
4.	Transient on X, Y, Z. Science data : Transients occurred intermittently throughout all tests	N/A	N/A	No reason can be found for this condition. Contractor is aware of problem since it existed on EM Tests. See See ATM 626 Table 3. 3. 4. 1 Item 7.
5.	LSM not in proper preset condition on turn-on: Cal-Inhibit not in, Presite Gimbal position not obtainable	N/A	N/A	This condition also existed in EM Tests. (ATM 626 Table 3. 3. 4. 1 Item 10).

MAGNETOMETER PROTOTYPE PROBLEM AREAS (con't.)

PROBLEM AREAS	ICS PARAGRAPH	ICS VALVE	REMARKS
6. Cal Raster from analog output of ETS garbled:	N/A	N/A	Jitter in raster appeared to be eliminated, however the digital filter was not in operation throughout tests. With the permanent offset to the sensor electronics and non-linear operation, it is impossible to determine if the Cal Raster is correct. See ATM 626-Table 3.3.4-1 Item 11.
7. Permanent offset in Sensor Electronics:	N/A	N/A	See ATM 626 Table 3.3.4-1 Item 12. Unable to null field with Helmholtz Coil with Solenoid was able to allow mid-scale reading on 400 gamma range.
8. Power ripple inconsistent:	N/A	N/A	See ATM 626 Table 3.3.4-1 Item 13. Power ripple changes during normal operation See photo Figure 2.3.8
9. No Z axis Sensor Electronics	N/A	N/A	See ATM 626 Table 3.3.4-1 Item 14.

MAGNETOMETER PROTOTYPE PROBLEM AREAS (con't.)

PROBLEM AREAS	ICS PARAGRAPH	ICS VALVE	REMARKS
10. Engineering Data for words 4 & 12 unstable:	N/A	N/A	See ATM 626 Table 3.3.4-1 Item 15 switches from 000-127 i.e. fulllscale oscillation.
11. Y and Z Data changed sign intermittently:	N/A	N/A	Since both channels were tied together - change should not occur.
12. Z offset cycle incorrect:	Table IV	N/A	See ATM 626 Table 3.3.4-1 Item 8.
13. Engineering Data 16 Frame Sub Commutator stops, skips and jumps intermittently:	3.2.2.2	Table III	See ATM 626 Table 3.3.4-1 Item 21 occurred throughout tests, appears associated with science data glitches.
14. Logic and power switching unduly sensitive to EMI:	3.2.5	MIL-I-26600 amended by MSL-ASPD-EMI-10A	See ATM 626 Table 3.3.4-1 Item 22.
15. Channel 7 Engineering Data Jitter:	N/A	N/A	Shifted 1 bit from 010 - 011. See ATM 626 Table 3.3.4-1 Item 23.

MAGNETOMETER PROTOTYPE PROBLEM AREAS (con't.)

PROBLEM AREAS	ICS PARAGRAPH	ICS VALVE	REMARKS
16. Current Ripple during Flip Cal with morots energized was greater than 75 ma for frequencies over 250 **HZ:**	3. 2. 3. 8 & 3. 2. 3. 9		See Figure 2. 3. 9 and 2. 3. 10.
17. Noise on Command & shift line:	3. 2. 2. 3. 8	Will not exceed 100 MV p. p. at experiment output	Exceeded 100 MV p. p. 150 MV recorded in Figure 2. 3. 6.

PSE PROTOTYPE PROBLEM AREA

	PROBLEM AREAS	ICS PARAGRAPH OR PERFORMANCE SPEC.	ICS OR PERFORMANCE SPEC. VALVE	REMARKS
1.	Incorrect thermal control sequence:	AL270000 Table VIII	Auto ON/OFF CMD ON/OFF	Thermal Control Sequence correct first attempt only. Failure to cycle thru four steps.
2.	No SP-Z Response to Exciter.	ICS Paragraph 3. 2. 6. 19. 2 & AL270000 3. 1. 1. 2	Simulator Unit shall provide stimuli signals during system test.	No 1HZ response ON SP-Z throughout all tests Problem first believed to be in ETS since engineering model did not respond to SP-Z test signal.
3.	SP-Z offset operated continuously at 3/4 scale.	N/A	N/A	Correct response unknown LPX, Y, Z operate at half scale.
4.	No response from instrument temp.	AL270000 Table I ICS Paragraph 3. 2. 2. 1	N/A	Correct response unknown
5.	No response to LPX, Y gain changes	ICS Paragraph 3. 2. 2. 3 AL 3. 4. 2. 1. 3	Attenuation to signals shall be commanded to 0, 10, 20, 30 db steps	No response noted in science data of housekeeping channel 23.
6.	Response to Exciter Signals not defined	ICS Paragraph 3. 2. 6. 14. 2	Functional Test of Parameters (a) thru (m) ICS.	Definition to perform functional test incomplete response on LP-Z not in ten DB steps.
7.	SP-Z Channel saturates after first change gain command	ICS Paragraph 3. 2. 2. 3 AL 270000 3. 4. 2. 1. 3	Attenuation to signals from amplifier shall be commanded to 0, 10, 20, 30 db steps	

PSE PROTOTYPE PROBLEM AREA (con't.)

PROBLEM AREAS	ICS PARAGRAPH OR PERFORMANCE SPEC.	ICS OR PERFORMANCE SPEC. VALVE	REMARKS
8. Response to LP & SP Cal not defined	See Item 6	See Item 6	See Item 6
9. Interaction ON LPX, Y, Z to SP Cal Command	AL270000 3. 1. 1. 14	Mechanical, Magnetic or electrical cross coupling between seismic will be less than 40 db	
10. Uncage command creates transients on LPX and tidal X channels	See Item 9	See Item 9	
11. Response to filter feedback command not defined	See Item 6 See Item 6	See Item 6	See Item 6
12. SP CAL command in interacts with LPZ	See Item 9	See Item 9	See Item 9
13. Power converter noise ON 29V line	ICS 3. 2. 3. 5	20 MV	Greater than 800 MV measured
14. Power Converter noise ON timing control and command lines	ICS 3. 2. 2. 7	100 MV	Greater than 400 MC on command lines.
15. Power Converter noise ON analog lines	———	———	Typical measured value 300 MV
16. Power Converter noise ON science data	———	———	Noise on data output, no Exciter input (exciter reset 4 LSB.

PSE PROTOTYPE PROBLEM AREA (con't.)

PROBLEM AREAS	ICS PARAGRAPH OR PERFORMANCE SPEC.	ICS OR PERFORMANCE SPEC. VALVE	REMARKS
17. No connection to survival power in PSE converter	ICS 3.2.3.2	_____	Not tested in Prototype Refer to ATM 618
18. 1 MS Rise time on positive going edge of uncage command pulse.	ICS 3.2.2.5	$\leq 10\mu$ sec.	See memo L. Lewis 9711-169 3 Mar. 67 not measured in Prototype
19. 29V Noise due to level Power Switch on	ICS 3.2.3.5	150 MV	See ATM 618 2.5 V p.p. not measured on Prototype

COLD CATHODE GAUGE EXPERIMENT PROBLEM AREA

PROBLEM AREAS	ICS PARAGRAPH	ICS VALVE	REMARKS
1. Noise on data lines	N/A	N/A	There is no ICS for this experiment. Typical ICS valve for this item is 100 MV p. p. See Figure 4.3.6